

## **APPENDIX 2. Detailed description of the specific methods used in the action-research program**

Action research is a methodology based on the collaboration of the researchers and those actors who are at the focus of the research (Susman and Evered 1978, Robson 2002). It is adequate for solving intricate, complex social problems through the collaborative understanding of their underlying causes, as well as of the institutional and organizational change needed to realize such solutions (Robson 2002). In applying this methodology, we assumed that the intervention of “external insiders” with the social expertise needed to promote and facilitate participative and inclusive processes of change, through the use of specific, qualitative methods (Robson 2002), could be instrumental in facilitating the transition from rigid to more flexible and adaptive institutional regimes for water resources management and wetland conservation in Doñana. We employed the following methods:

### **Actor identification (11/25/2006-05/22/2007)**

Actor identification consisted in the selection and categorization of actors on the basis of previously established criteria (Table A2.1). In particular, we used the historical criterion elaborated after the analysis presented here, Mostert’s four criteria for stakeholder identification (Mostert 2006:163), and the three levels of the Institutional Analysis and Development framework (IAD; Kiser and Ostrom 1982, Ostrom 1999, Ostrom 2005). Such criteria allowed us to classify actors in two categories: decision makers (actors with enough power to make a final choice among alternatives in policy making or project implementation processes) and stakeholders (actors who can affect or are affected by the achievement of new policy or project goals, or by those of the action-research program).

**Table A2.1.** Criteria used for the selection and categorization of actors in our case study.

<b>Historical criterion</b>
He/She or his/her organization has historically participated in the past or recent development of the institutional regimes for water resources management or wetland conservation in Doñana.
<b>Mostert’s criteria</b>
A. He/She possess relevant information about the case study.
B. He/She can actively contribute to the development of new policy or projects.
C. His/Her interests will be directly affected by the action-research program and any potential process of change.
D. He/she can obstruct decision making or frustrate policy or project implementation.
<b>IAD’s levels of inquiry</b>
A. Constitutional level (constitutional decisions, actions and rules directly affecting the collective-choice level).
B. Collective-choice level (collectively-chosen decisions, actions and rules directly affecting the operational level).
C. Operational level (day-to-day decisions, actions and rules directly affecting water management and/or wetland conservation).

Following these criteria, we identified a total of 40 actors, of which 34 were finally contacted (the other 6 were either unavailable, retired or on sabbatical). 25 of them were available for interviewing in the first phase (1h on average by the same researcher), 7 took part in the uncertainty workshop, and 24 took part in the research-management workshop (though only 15 participated in the Group Model Building session; see Table A2.2 and the Workshops section below). All actors (38% decision makers, 62% stakeholders) met our historical criterion, and at least two of Mostert's criteria at any of Ostrom's levels. Decision makers met at least three specific Mostert's criteria (B, C and D) (Table A2.2). Key decision makers predominantly belonged to agencies with direct management duties over the Doñana Nature Reserve, such as its Administration Office (Regional Ministry of Environment), the Doñana Biological Station (Ministry of Education and Science) and the Guadalquivir River Authority (Ministry of Environment). Stakeholders included officers from the Andalusian Ministry of Environment (Andalusian Water Agency and Nature Reserves Network), academics from (national and Andalusian) universities and research agencies, and the WWF.

**Table A2.2.** Identified actors (UW = uncertainty workshop, RMW = research-management workshop, DM = decision maker, SH = stakeholder).

ID	Organization	Criteria and category				Interview	UW	RMW
		Historical	Mostert	Ostrom	Category			
A1	Doñana Nature Reserve	Yes	A, B, C, D	A, B, C	DM	Yes	No	Yes
A2	Doñana Nature Reserve	Yes	A, B, C, D	B, C	DM	Yes	No	Yes
A3	Doñana Nature Reserve	Yes	A, B, C, D	B, C	DM	Yes	No	Yes (+)
A4	Doñana Nature Reserve	Yes	A, B, C, D	B, C	DM	Yes	Yes	No
A5	Doñana Nature Reserve	Yes	A, B	C	SH	No	No	Yes (+)
A6	Doñana Biological Station	Yes	A, B, C, D	A, B, C	DM	Yes	No	No
A7	Doñana Biological Station	Yes	A, B, C	B, C	DM	No	No	Yes
A8	Doñana Biological Station	Yes	A, B	C	SH	Yes	No	Yes
A9	Doñana Biological Station	Yes	A, B	C	SH	Yes	No	No
A10	Doñana Biological Station and Reserve	Yes	A, B, C, D	B, C	DM	Yes	No	Yes (+)
A11	Doñana Biological Station	Yes	A, B	C	SH	Yes	No	No
A12	Doñana Biological Station and Reserve	Yes	A, B	C	SH	Yes	No	Yes (+)
A13	Doñana Biological Station	Yes	A, B, C, D	B, C	DM	Yes	No	No
A14	Doñana Biological Station	Yes	A, B	C	SH	No	No	Yes
A15	Doñana Biological Station	Yes	A, B	C	SH	Yes	Yes	Yes (+)
A16	Doñana Biological Station	Yes	A, B, C, D	B, C	DM	Yes	No	No
A17	Doñana Biological Station	Yes	A, B	C	SH	Yes	Yes	Yes (+)
A18	Doñana Biological Station	Yes	A, B	C	SH	No	No	Yes (+)
A19	Doñana Biological Station	Yes	A, B	C	SH	No	No	Yes (+)
A20	Doñana Biological Station	Yes	A, B	C	SH	No	No	Yes
A21	Guadalquivir River Authority – Water Planning Office	Yes	A, B, C, D	A, B, C	DM	No	Yes	Yes (+)
A22	Guadalquivir River Authority – Seville Area Office	Yes	A, B, C, D	A, B, C	DM	Yes	Yes	Yes (+)
A23	Andalusian Water Institute – Doñana 2005 Project	Yes	A, B, C, D	A, B, C	DM	Yes	No	No
A24	Andalusian Water Institute – Doñana 2005 Project	Yes	A, B	B, C	SH	No	Yes	No
A25	Andalusian Water Agency – Doñana 2005 Project	Yes	A, B	B	SH	Yes	No	Yes (+)

**Table A2.2 (cont'd).** Identified actors (UW = uncertainty workshop, RMW = research-management workshop, DM = decision maker, SH = stakeholder).

ID	Organization	Criteria and category				Interview	UW	RMW
		Historical	Mostert	Ostrom	Category			
A26	Andalusian Water Agency – Doñana 2005 Project	Yes	A, B	C	SH	Yes	No	No
A27	Andalusian Nature Reserves Network – Directorate General	Yes	A, B, C, D	A, B, C	DM	Yes	No	Yes
A28	University of Seville – Doñana 2005 Project	Yes	A, B	C	SH	Yes	No	Yes (+)
A29	University of Seville	Yes	A, B	C	SH	Yes	No	Yes
A30	University of Huelva – Doñana 2005 Project	Yes	A, B	C	SH	Yes	No	Yes (+)
A31	University of Córdoba – Doñana 2005 Project	Yes	A, B	C	SH	Yes	No	No
A32	Polytechnic University of Catalonia – Doñana 2005 Project	Yes	A, B	C	SH	No	No	Yes
A33	Institute for Prospective Technological Studies (European Commission's Joint Research Centre)	Yes	A, B	C	SH	Yes	No	No
A34	WWF/Adena Doñana Office	Yes	A, B, C	A, B	SH	Yes	No	Yes (+)
-	Mediterranean Institute for Advanced Studies – Doñana 2005 Project <sup>†</sup>	-	-	-	-	-	Yes	-
-	Sierra Nevada Nature Reserve	-	-	-	-	-	-	Yes (+)
<b>Totals</b>	<b>34</b> (latter two excluded from count)	<b>13 DM (38%) and 21 SH (62%)</b>				<b>25</b>	<b>7</b>	<b>24 (15)</b>

(+) Actor that stayed and participated in the GMB (third) session of the RMW.

<sup>†</sup> L. Santamaría was invited externally by organizer N. Insendahl to participate in the UW (co-organized with P. F. Méndez), before she joined the research program; both then acted as organizers together with P. F. Méndez and J. Amezcaga in the RMW.

### **Semi-structured, open-ended interviews – question guides (06/19/2007-10/26/2007)**

#### 1. What is the function of your organization?

Primary themes (non-consecutive, alternative):

- Function in the field of water resources in the Guadalquivir Estuary.
- Function in the field of wetland conservation in the Guadalquivir Estuary.
- More specific function within the Doñana Nature Reserve.

#### 2. What type of organization is it (public, private, non-profit)?

#### 3. Which are your duties within your organization?

#### 4. What is your general perspective about water resources management in Doñana and the Guadalquivir Estuary?

Primary themes (subsequent and consecutive):

- General perspective and opinion.
- EU's policies and legislation.
- National and regional policies and legislation.
- Research and management.
- Operational management.

5. What is your general perspective about wetland conservation in Doñana?

Primary themes (subsequent and consecutive):

- General perspective and opinion.
- EU's policies and legislation.
- National and regional policies and legislation.
- Research and management.
- Operational management.

Let's talk about the "Doñana 2005" Eco-Hydraulic Restoration Project.

6. What problem was being assessed?

7. What is your general perspective about the management of the Doñana 2005 Project?

Primary themes (subsequent and consecutive):

- General perspective and opinion.
- Research and management.
- Operational management.

8. More specifically, what is your general perspective of the restoration action carried out at the Caracoles Estate which, as you might know, was designed under adaptive management tenets?

Primary themes (subsequent and consecutive):

- General perspective and opinion.
- Research and management.
- Operational management.

We define institutions as "the prescriptions that humans use to organize all forms of organized, established, social procedures (formal and informal rules, organizations, epistemological domains and technologies)" (Brief explanation of definition and specific elements if requested).

9. Which were the main opportunities and barriers that such action encountered in the institutional realm?

Primary themes (non-consecutive, alternative):

- Formal (e.g., legislation, policies) and informal rules (e.g. innovation networks, lobbies).
- Organizations (e.g., research organizations –universities, institutes–, management agencies).
- Scientific-technical perspectives (as a surrogate of epistemological domains; e.g., command-and-control approaches, ecosystem-based and adaptive management).
- Technologies (e.g., information technologies).

## **Workshops**

### ***Uncertainty workshop (12/05/2007)***

The uncertainty workshop aimed at preliminarily identifying uncertainties in water management and nature conservation in the Doñana Nature Reserve and the Guadalquivir Estuary from the perspective of practitioners. It was held as a focus group, involving 7 key actors for water management and conservation in the Guadalquivir estuary. The workshop first assessed how the

participants perceived and framed uncertainty. In an open discussion, they identified several situations of uncertainty relevant to their professional work and, on the basis of these situations of uncertainty, shared parameters were interactively developed making use of the card-sorting method. During the workshop, the need to explicitly take uncertainties into account was made explicit and a reflection process about the approaches required to make such realization operative was instigated. The workshop showed that there is a considerable variety of uncertainties that actors in water management have to deal with. Their conceptualization by the different actors was explicitly captured and reflected in a final list of 13 uncertainty situations (Table A2.3). This exercise and the derived set of parameters constituted a first step towards making approaches for dealing with uncertainty more explicit and structured in our case study (see Isendahl et al. 2010 for a more detailed description of the workshop organization and results).

**Table A2.3.** Uncertainty workshop. Upper panel: situations of uncertainty relevant to the professional work of the participants. Lower panel: shared parameters.

Situations of uncertainty
1. How to communicate uncertainties to the public?
2. How to set priorities when dealing with several uncertainties?
3. How would the marshlands react to the removal of the dike?
4. What are the socio-economic consequences of the WRM in the region?
5. What do we know about the natural system (marshlands)?
6. What Doñana/marshlands do we want?
7. What is the security of an economic investment?
8. Have I considered all uncertainties?
9. How does the society react on a management decision? (example Agrio reservoir and question of distribution of water)
10. How does the agricultural sector evolve (e.g. effects of Common Agricultural Policy change)?
11. How do the different interests affect decision-making in management?
12. How to predict the medium recharge of the aquifer?
Shared parameters
1. Capacity to tackle the uncertainties
2. Type of uncertainty/sectoral structure
3. Urgency/Priority to deal with the uncertainties
4. Conceptual clarity/knowledge about the problem or the uncertainty
5. Level of action
6. Recognition of the uncertainty as such by the public
7. Strategy to tackle the uncertainties
8. Capacity to assess the unforeseen consequences of the uncertainty
9. Cause of the uncertainty

### ***Research-management workshop (04/02/2008)***

The research-management workshop involved a group of 24 of the identified actors (Table A2.2) and focused on the improvement of the research-management interface in the Doñana Nature Reserve and the Guadalquivir Estuary. As has been shown, it constitutes a critical element in the region, due to the historical weight of the competitive (often conflictive) trade-off between water resources management and wetland conservation goals. Prior to the workshop, and based on our preliminary analysis of the interviews and the results of the uncertainty workshop, the following

management and governance problems were listed in a whiteboard (placed visible and presented to all the participants at the outset of the workshop):

- The absence of a strategic framework for the region.
- The lack of water management and wetland conservation goals.
- The lack of a shared model of the structure and functioning of the Doñana wetland ecosystems.
- The ignorance of key uncertainties.
- The absence of pre-defined goals for monitoring programs (in spite of their long-term and coordinated character).
- The absence of evaluation and learning mechanisms (institutions, protocols, standards, coordinating individuals, champions, etc.).

The workshop was divided in three parts. Firstly, we introduced our action-research program and presented adaptive management as a potential tool to introduce dynamism and learning capacity into the research-management interface. As an example, we provided an overview of the challenges and successes faced by a number of projects that had applied adaptive management elsewhere (with an emphasis on British Columbia, Canada; see Méndez et al. 2010 for a review). We also summarized the results of the uncertainty workshop.

Secondly, we organized four thematic talks (about nature conservation, research, water management and hydro-ecological restoration), presented by key decision makers and followed by facilitated discussion. In the discussion, several problems related to conservation, research and water management in the Doñana Nature Reserve emerged. The session concluded with the synthesis of such problems, their conversion into objectives and the elaboration of a shared list of recommendations to foster the improvement of the research-management interface (see Table 4 from main text).

Thirdly, we organized a session of participatory modeling (with only 15 of the initial participants, owing to agenda constraints of the rest) that was performed in two separated groups, respectively focused on two key components of the management of Doñana's aquatic ecosystems: water and vegetation. These elements had been identified during the preceding interviews and historical analysis, as being both central to the management of these ecosystems and inter-related to most other relevant elements. We used Group Model Building as a method facilitating the sessions (Vennix 1996, Andersen et al. 1997). Each group, guided and moderated by a facilitator, worked on jointly building one causal model following a classic approach – focusing on simple mechanisms to build causal relationships (see Vennix 1996). Both models were then presented in a plenary session and used for group discussion.

The “water-management group” built a model aimed at achieving “sustainable water management regimes that ensure the long-term conservation of the biodiversity hosted by the Doñana Nature Reserve marsh/wetland ecosystems” (Fig. A2.1), whereas the “vegetation management group” built a model aimed at achieving “the sustainable management of the vegetation of the Doñana Nature Reserve marsh/wetland ecosystems (and its grazers), in order to assure the conservation of the biodiversity hosted by them” (Fig. A2.2). Participants were asked to identify first-order (directly influencing the main goal) and second-order (directly influencing first-order factors) drivers of change towards the accomplishment of the main goals (Table A2.4). Additional goals during the discussions were (1) to work towards a shared understanding of water management and nature conservation in the Doñana region, and (2) to collectively identify options of institutional change.

Finally, both groups were asked to identify key sources of uncertainty in the modeled subsystems (water and vegetation) – which were contrasted with those reported in the uncertainty workshop.

**Table A2.4.** Synthesis of first-order and second-order causes recognized as drivers of change towards the accomplishment of the main goal, by the participants in the research-management workshop’s Group Model Building sessions.

Session	Main goal	First-order causes	Second-order causes
Water	Sustainable water management regimes that ensure the long-term conservation of the biodiversity hosted by the DNR’s marsh/wetland ecosystems.	<ul style="list-style-type: none"> <li>- The improvement of knowledge on ecosystem functioning.</li> <li>- The promotion of social dialog in the affected region.</li> <li>- The clear definition of management and conservation criteria (e.g. water quantity and quality needs).</li> <li>- The improvement of inter-agency and trans-disciplinary coordination.</li> <li>- The management of the ‘Doñana sub-basin’</li> </ul>	<ul style="list-style-type: none"> <li>- The implementation of long-term monitoring programs.</li> <li>- The free availability and transfer of results from these programs.</li> <li>- The development of standards and technologies for information sharing and transference.</li> <li>- Socioeconomic research.</li> <li>- Political support (was envisaged as instrumental) for the elaboration of collective, shared management and conservation criteria.</li> <li>- Environmental education (driver of change affecting the whole model).</li> </ul>
Vegetation	Sustainable management of the vegetation of the DNR’s marsh/wetland ecosystems (and its grazers), in order to ensure the conservation of the biodiversity hosted by them.	<ul style="list-style-type: none"> <li>- The adjustment of the herbivore load to the temporal fluctuations and spatial variation in the marsh’s carrying capacity.</li> <li>- The adequate implementation, on the ground, of the DNR’s planning and management instruments.</li> <li>- The collective building of a system’s functioning model (including hydrologic, climatic and vegetation dynamics).</li> <li>- The introduction of preventive management strategies (e.g. risk management, prevention and control of alien species).</li> <li>- The establishment of water quantity and quality criteria.</li> </ul>	<ul style="list-style-type: none"> <li>- The reduction of erosion through hydraulic restoration of streams.</li> <li>- The improvement of agricultural planning.</li> <li>- The re-evaluation and improvement of the existing legal instruments.</li> <li>- Knowledge generation and information gathering through research and monitoring.</li> <li>- Environmental education (driver of change affecting the whole model).</li> <li>- Future reforms of EU’s policies (e.g., Water Framework Directive, Common Agricultural Policy) (driver of change affecting the whole model).</li> </ul>

Fig. A2.1. Water-management model.

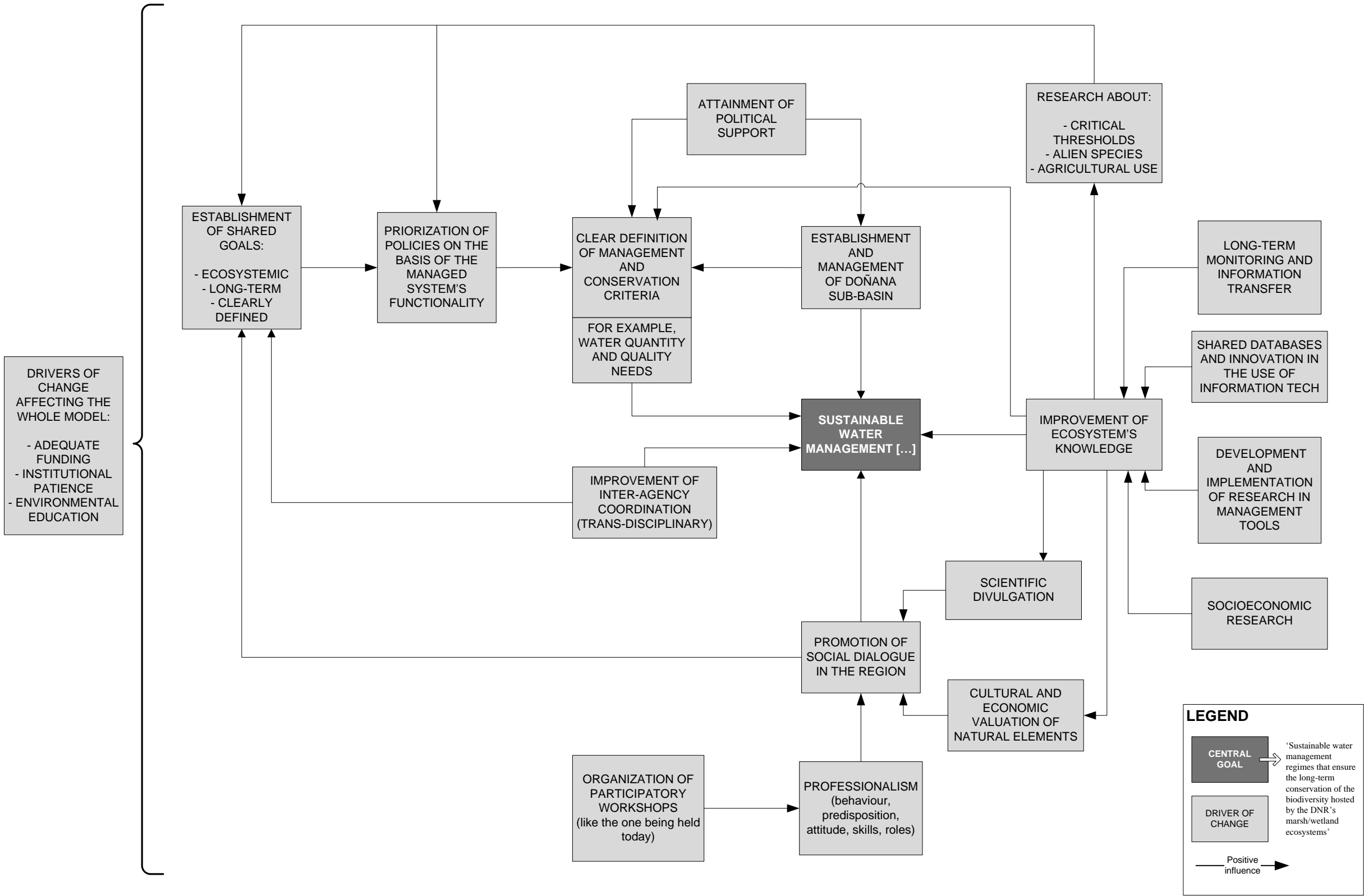




Fig. A2.2. Vegetation-management model.

